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Full Array vs Edge-lit LED LCD Comparison

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LED (Light Emitting Diode) are the exciting new replacement for the ubiquitous CCFL (Cold Cathode Fluorescent Lamp) for backlighting of LCD HDTVs/displays. LCD displays require backlighting as liquid crystals do not emit light but, rather act as shutters controlling light. The comparatively poorer black levels (charcoal instead of black) of LCD compared to plasma displays comes from the imperfect closing and associated light leakage from the millions of tiny liquid crystal shutters in a LCD display.

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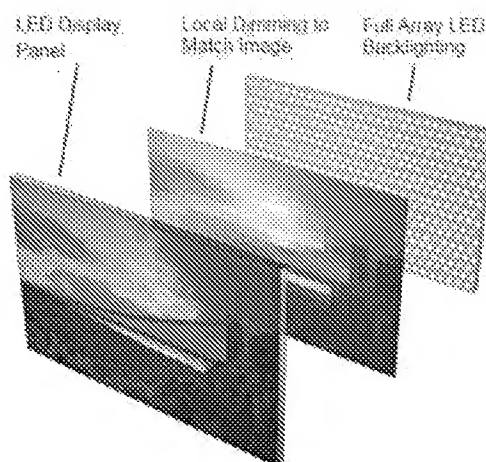
LED Backlighting Types

There are two major types of LED backlighting arrangements used for LCD HDTVs – full array (or matrix) backlighting and edge-lit.

Full Array Backlighting

Full array backlighting refers to an even array/matrix of LED backlights placed behind the a diffuser and the liquid crystal display itself. The diffuser is required to ensure that the LED backlighting is spread uniformly across the back of the LCD display panel. This arrangement achieves a superior uniformity to that of edge-lit LED LCD HDTVs.

A technology which is closely associated with LED backlighting is **local dimming** which is the dimming of the LED backlighting in certain areas of the display which are meant to be displaying the darker elements of a scene. This provides some hundredfold increase in contrast ratio bringing values for LCD HDTVs much closer to the levels achieved by plasma displays which have, until now, held a distinct advantage. The black levels and contrast ratios achieved exceed those currently possible with edge-lit LED LCD.



A problem which can (and has) occurred with local dimming is the manifestation of blooming around bright objects set against a dark background. It is the result of an imperfect match of the brighter backlit area to the displayed bright object area and the leakage of the brighter backlight through liquid crystal shutters surrounding it. Manufacturers have addressed this problem by increasing the number of LEDs and/or reducing the number of LEDs in blocks of controlled backlighting (finer lighting control).

The variation of the full array backlighting arrangement is the replacement of white LEDs clusters of color LEDs (two green, one red, one blue) which combine to make a purer white light. The purer white light produces a wider color gamut and therefore allows more accurate, or lifelike, rendering of colors. Sony has trademarked this more expensive technology as Triluminos.

It should be noted that manufacturers have exceeded HDTV color gamut specifications using white LEDs.

Edge-lit LED LCD Displays

Edge lighting is the placement of LEDs along the edges of an LCD display. Even dispersion of the backlighting is achieved by a highly reflective light plate which is mounted directly behind the display and reflects the LED light at a 90 degree angle to pass out through the LCD panel. The guide plate is covered by tiny raised bumps which are graduated from smaller at the extremities to the taller at the center of the screen. This arrangement produces a uniform enough backlighting of the display that a diffuser panel is not required. Dispensing with a diffuser and its associated illumination loss boosts the energy efficiency of an edge-lit LED LCD in comparison to the full array type. A trade-off (of not having a diffuser) is a greater likelihood of hot spotting (areas of higher illumination) than with full array LED LCD if the light guide plate design is not optimal.

Until recently, LED lights in edge-lit LED LCD HDTV displays could be dimmed in groups to improve black levels but, not individually. The lighting control areas tended to be large reducing the effectiveness. In an effort to deliver the best attributes of both current LED backlighting approaches, HDTV manufacturers have been striving for performance improvements. With the recent release of its C8000 and C6800 LED LCD models with Precision Dimming technology, Samsung seems to have won the race. Special edge mounted LEDs enable the controlled lighting of variable size, diamond-shaped areas effectively providing local dimming. Higher contrast ratios, deeper blacks and energy savings are achieved by lighting being varied in intensity to match what is required for the frame being shown. By sticking with edge-lit displays Samsung retains the 30% to 40% cost advantage over full array LED panels (according to research firm DisplaySearch) and the desirable ability to manufacture thinner displays. Obviously this places market pressure on other HDTV manufacturers.

In considering the deeper black level and contrast advantages of full array backlighting, it should be remembered that they only manifest in the small proportion of darker scenes of video content. The contrast difference is also lessened by the ability of edge-lit LED LCD to produce brighter white areas (no diffuser).

Full Array vs Edge-lit LED LCD in Summary


Initially, there has been some difference in picture quality between full array LED LCD with local dimming and edge-lit LED LCD displays. However, 2010 is promising to deliver edge-lit LED LCD models which are a closer match. If price is not a restriction then the best LED LCD HDTVs are full array tri-luminous LED LCD with local dimming as produced by Sony.

On the Horizon

Dramatic improvements in the color accuracy of LED LCD HDTVs should arrive with **Quantum Dot technology**. Developed especially for LED backlighting in LCD HDTVs, quantum dots promise to deliver exceptional color quality – being able to

reproduce the full spectrum of colors the human eye can perceive. In addition, the elimination of color filters will deliver higher brightnesses and improved power efficiency. Read PresentationTek's review of [Quantum Dot technology](#).



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